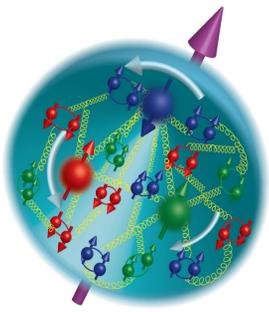


## INTRODUCTION

### SPIN STRUCTURE OF THE PROTON



spin sum rule

$$\langle S_p \rangle = \frac{1}{2} \left[ \frac{1}{2} \Delta\Sigma + \Delta G + L \right]$$

### Quark / antiquark Contribution

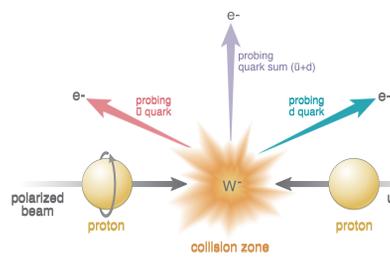
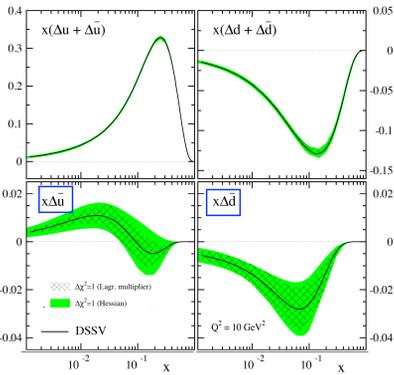
$$\Delta\Sigma = \int (\Delta u + \Delta d + \Delta s + \Delta\bar{u} + \Delta\bar{d} + \Delta\bar{s}) dx \sim 30\%$$

DSSV global analysis of helicity PDF

- Large uncertainty for sea quark polarization

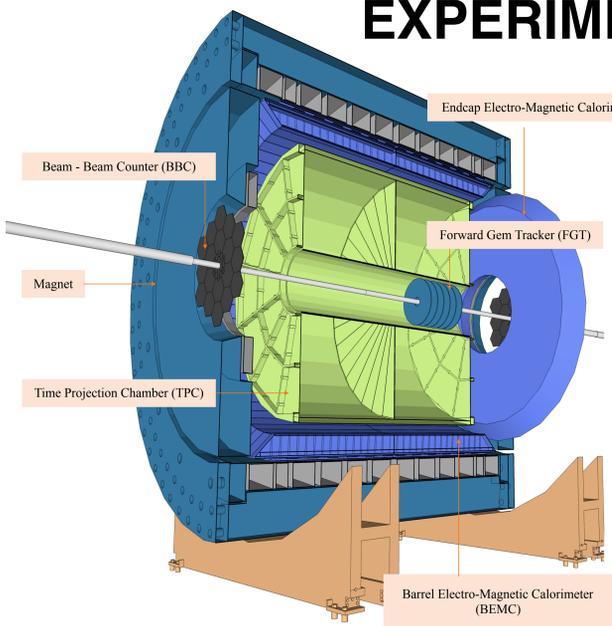
### W Boson Production in polarized p+p collisions

- Direct access to  $\Delta q / \Delta\bar{q}$
- Easy detection



- No fragmentation involve.
- Maximum parity violation

## EXPERIMENT



### STAR Detector

**TPC** :  $-1.3 < \eta < +1.3$ ,  
Tracking and Particle ID

**BEMC** :  $-1.0 < \eta < +1.0$

**EEMC** :  $+1.1 < \eta < +2.0$

**Barrel and Endcap 2π calorimetry**

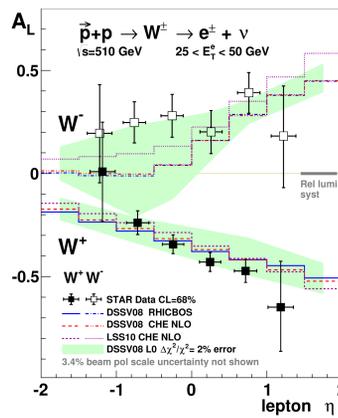
**BBC / ZDC** :

**Relative Luminosity**

## RESULTS

### STAR Run 2012 W AL Published Results

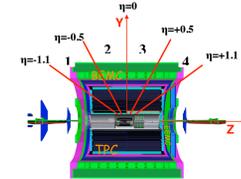
- Large anti u quark polarization than theoretical prediction



single spin asymmetry

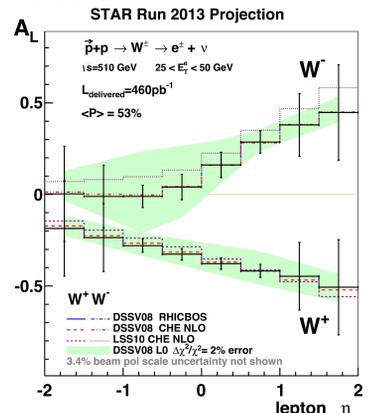
$$A_L = \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-}$$

$$A_L = \frac{1}{P_1} \frac{N_{++} + N_{--} - N_{+-} - N_{-+}}{N_{++} + N_{--} + N_{+-} + N_{-+}}$$

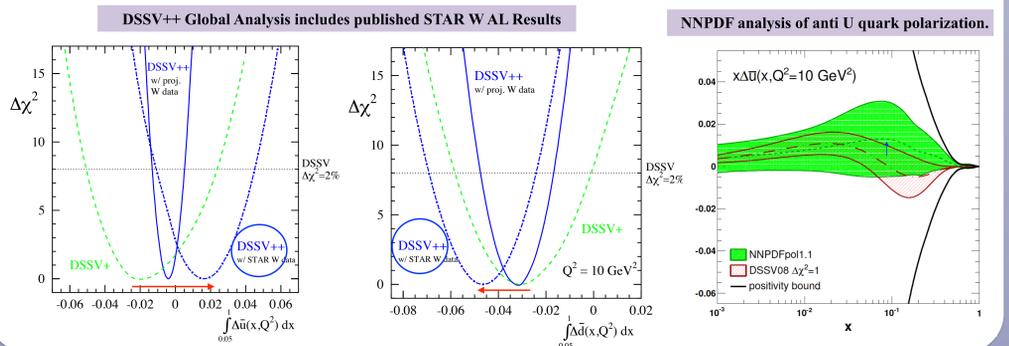


### STAR Run 2013 W AL Projections

- Large data set in run 2013 expect to reduce uncertainty further



### Impact of Recent STAR W AL Results on Recent Global Analyses and Predictions for future STAR Results



## CONCLUSION

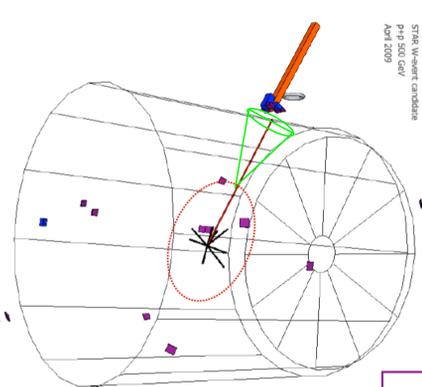
- The production of W bosons in polarized P+P collisions provides an excellent way to study the spin and flavor asymmetries of the proton quark and antiquark distributions.
- STAR has measured the parity violating single spin asymmetry  $A_L$  for pseudo-rapidity between -1.4 and +1.4 from STAR 2012 and 2011 data providing the first detailed look at the asymmetries  $\eta$  dependence.
- STAR 2012 W  $A_L$  results provide significant constraints on anti u and anti d quark polarizations.
- Large data set of STAR 2013 is being analyzed currently in mid rapidity region (pseudo-rapidity between -1.0 and +1.0) and expects results reduce uncertainty further.
- High precision results from STAR 2013 data will improve the constraints on the anti u and anti d quark polarizations.

## ANALYSIS

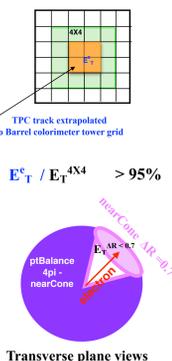
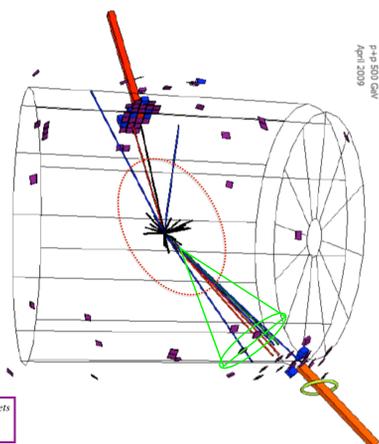
### Reconstruction of W bosons from decay electron and positrons

- Isolated high energetic TPC tracks pointing to calorimeter tower. Energy from the maximum 2x2 cluster.
- Undetected neutrino leads to large opposite missing energy, large imbalance in the transverse momentum.
- Cuts designed to take the advantage of topological difference between W and QCD type BG event

### Calorimeter response from a simulated W event



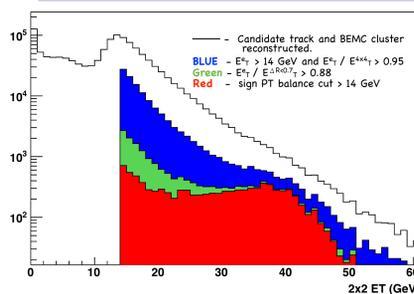
### Calorimeter response from a simulated QCD type di-jet background event



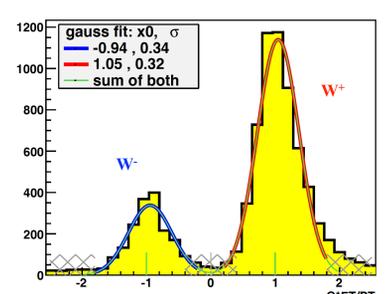
$$E_T^c / E_T^{AR} < 0.7 > 88\%$$

$$\vec{p}_T^{balance} = \vec{p}_T^c + \sum_{\Delta R > 0.7} \vec{p}_T^{jets}$$

### W candidate tracks as a function of transverse Energy



### TPC Charge sign separation



### Background Estimation

- QCD BG using data driven procedure
- Electroweak BG (W → τ, Z → e+e-) using MC simulation

